

Project Summary: Cover Crop Integration for Sustainable Wheat Production in Iran (2017–2021)

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Project Title: Agronomic and Economic Impacts of Cover Crops on Irrigated Wheat Productivity under Reduced Tillage and Raised Bed Systems

Duration: 4 years and 6 months

Project Code: 960503-055-03-03-2

I. Background & Problem Statement

Intensive irrigated wheat systems in Iran face mounting challenges: soil erosion, declining organic carbon, herbicide-resistant weeds, nutrient stratification, and poor carbon distribution. Conventional practices have failed to address these issues sustainably. This project aimed to evaluate the agronomic and economic benefits of integrating cover crops and green manure species into wheat-based systems using conservation agriculture principles.

II. Methodology

The study was conducted in temperate regions of Alborz Province using a comprehensive 11-point conservation protocol over three consecutive cropping seasons:

- **No burning of wheat residues;** biomass returned to soil
- **Short summer fallow** followed by cover crop planting in mid-August
- **Reduced tillage** using disc harrows (no moldboard plowing)
- **Raised bed planting** for both cover crops and wheat
- **No chemical inputs** for cover crops
- **Weekly irrigation** from well water
- **Sequential rotation** with fixed field plots over four years

Cover crops included: sorghum, sudangrass, forage millet, rye, clover, cowpea, vetch, oats, sesame, safflower, soybean, and fenugreek.

III. Key Findings

Agronomic Outcomes

- **Wheat yield increased by 24%** over three years (from 6,760 to 8,489 kg/ha)
- **Soil organic carbon rose from 0.25% to 0.81%**
- **Water productivity improved by 50%**, with irrigation intervals doubled
- **Top-performing cover crops for wheat yield:**
 - Forage millet: 9,518 kg/ha
 - Sudangrass: 9,029 kg/ha
 - Mung bean & canola: ~8,900 kg/ha

Soil Improvements

- Enhanced **cation exchange capacity, porosity, aggregate stability, and nitrogen levels**
- Improved **carbon-to-nitrogen ratio, water retention, and soil color**
- Biomass production of cover crops ranged from 8,800 to 12,000 kg/ha (dry matter)

Economic Analysis

- **Average net income from wheat:** 111.1 million IRR/ha
- **Highest income:** 124.1 million IRR/ha with forage millet
- **Return on investment (ROI):**
 - Average: 23.4%
 - Forage millet treatment: 73.1%
- **Cost structure:** 93.6% of expenses attributed to wheat production

IV. Conclusion & Recommendations

The integration of cover crops under reduced tillage and raised bed systems significantly enhanced wheat productivity, soil health, and water efficiency. The system proved economically viable and environmentally beneficial, with observable improvements within 60 days of cover crop establishment.

This model is recommended for adoption in temperate irrigated wheat zones and can serve as a blueprint for regenerative agriculture in semi-arid regions globally.